



Nitrate in Drinking Water

Fact Sheet

What is Nitrate?

Nitrate (NO_3^-) is a nitrogen-containing compound that is essential to all life forms. Nitrate is the primary source of nitrogen for plants and is present in all vegetables and grains. It is not uncommon to find small concentrations of nitrate naturally occurring in ground water. Natural sources of nitrate include soil nitrogen, nitrogen-rich geologic materials, and atmospheric deposition. However, higher concentrations of nitrate are generally associated with human activities and can cause adverse health effects in both humans and livestock. Sources of excess nitrate in ground water include fertilizers, dry land cultivation practices, septic system effluent, untreated or poorly treated sewage, livestock wastes, industrial wastes, food processing wastes, and decaying organic matter.

How Does Nitrate Get Into Ground Water?

Plants can only absorb a limited quantity of nitrate from the soil. Since nitrate is a very soluble compound, excess nitrate is leached downward through the soil by water from rainfall, snowmelt, or irrigation. If nitrate is leached below the root zone it may impact ground water. Shallow ground water is most susceptible to nitrate impacts and the potential for nitrate contamination in drinking water from wells is dependant on the depth and construction of the well. A shallow well, or a well that is improperly constructed or maintained, is more likely to be contaminated by nitrate.

What are the Health Effects of Nitrate?

Nitrate is considered relatively non-toxic to healthy adults but is a major health risk to infants under the age of 6 months. When nitrate is ingested, bacteria in the digestive system transform nitrate into nitrite. Nitrite reacts with the hemoglobin of red blood cells and reduces the ability of the blood to transport oxygen. This leads to a condition known as methemoglobinemia, or "blue baby syndrome", in which the blood does not have the ability to carry sufficient oxygen to the individual body cells. The lack of oxygen causes the skin to turn a blue or grayish color, especially around the eyes and mouth. Most adults have the ability to rapidly convert the nitrite back to nitrate and therefore generally show no acute effects of nitrate ingestion.

In addition to infants, pregnant women and nursing mothers should avoid drinking water with high nitrate concentrations since nitrate may be passed on to the fetus or infant. Adults with chronic health problems are

also considered susceptible to high levels of nitrates. There are also studies suggesting that nitrate is a potential cancer risk, however, little is known about the long-term chronic effects of drinking water with high nitrate concentrations.

Getting Your Water Tested

Nitrate in drinking water is tasteless and odorless, so the only way to be sure if your water is impacted is to have it tested. You can obtain a nitrate sampling kit from the Montana Department of Public Health and Human Services (DPHHS) Environmental Laboratory in Helena at (406) 444-2642 (<http://www.dphhs.mt.gov>) or through a commercial laboratory (<http://waterquality.montana.edu>). These kits should contain sample bottles, sampling instructions, and return mailing information. Be sure to follow the sampling instructions to ensure accurate results. Your drinking water should be tested every one to three years unless you know you have high nitrate concentrations, in which case your water should be tested at least twice per year. It is also recommended that you test for bacteria content while you are testing for nitrates.

Interpreting Test Results

The laboratory will report nitrate concentrations in milligrams per liter (mg/L) or in parts per million (ppm). These two concentration units are equivalent, i.e., 1 mg/L = 1 ppm. Most laboratories will give nitrate results as nitrate-nitrogen ($\text{NO}_3^- \text{N}$), which is the amount of nitrogen present as nitrate. Some laboratories will give results as total nitrate (NO_3^-). Make sure to determine which quantity, nitrate-nitrogen ($\text{NO}_3^- \text{N}$) or total nitrate (NO_3^-), is reported on your laboratory results since the two results mean very different things (10 mg/L nitrate-nitrogen = 44.3 mg/L total nitrate).

How Much Nitrate is Dangerous?

The Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (DEQ) are responsible for determining drinking water standards for public water supplies in Montana. The EPA has set the maximum contaminant level (MCL) for nitrate at 10 mg/L nitrate-nitrogen ($\text{NO}_3^- \text{N}$), or 45 mg/L total nitrate (NO_3^-). Public water supplies, defined as those that have 15 or more connections or regularly service more than 25 people, are routinely tested for nitrate and must comply with the MCL standard. Individual private water supplies are not required to meet drinking water standards, but the health risk are still the same.

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What Should I do if My Water Contains Nitrate?

If the nitrate concentration in your water is equal to or greater than 10 mg/L nitrate-nitrogen ($\text{NO}_3\text{-N}$), or 45 mg/L total nitrate (NO_3^-), the following steps are recommended:

- Do not give water to infants less than 6 months old and stop drinking the contaminated water if you are pregnant or nursing. If you are using infant formula prepare it with bottled water.
- Seek immediate medical help if the skin of an infant appears bluish or gray in color. The color change is generally first noticed around the mouth or eyes, or on the hands and feet.
- Limit your daily intake of water if you have chronic health problems that may increase your sensitivity to nitrate (consult your doctor), or if you have concerns about the scientific uncertainty regarding the health effects of long term exposure to nitrate.
- Do not boil water to treat for nitrate, this will actually increase the concentration.
- Water with high nitrate concentrations is still safe for bathing, laundry, cleaning dishes or other activities where the water is not ingested. Bottled water is the most convenient option for drinking and cooking.
- Try to identify the source of the nitrate contamination and take actions to manage or remove those sources. These actions may include reducing fertilizer use, moving manure piles, pumping or moving septic systems, or upgrading your well. Even though a potential nitrate source has been removed, it may take several years for nitrate concentrations in your well water to begin to drop.
- Monitor your nitrate levels at least twice each year (once in the summer, and once in the winter).
- Treatment options for nitrate contaminated water include reverse osmosis, distillation, and ion exchange systems. These treatment systems require careful maintenance to be effective. Reputable water conditioning equipment dealers can help choose an appropriate treatment system. Charcoal filters, water softeners, or the use of chlorine do not remove nitrate from water.

Where Can I Go For Additional Information?

Montana Dept. of Agriculture, Ground Water Program

Rick Mulder (406) 444-5400

Bob Church (406) 444-5400

Montana Dept. of Public Health and Human Services

(406) 444-4542 <http://www.dphhs.mt.gov>

Montana Dept. of Environmental Quality

(406) 444-2544 <http://www.deq.state.mt.us>

County Extension Agent

Personal medical providers

Web Resources

MSU Extension Water Quality Program

<http://waterquality.montana.edu>

Natural Resources Conservation Service

<http://www.nrcs.usda.gov>

EPA Safewater Page

<http://www.epa.gov>

World Health Organization

<http://www.who.int>

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